

Chapter 2 General Considerations

2-1. Coordination

The coordination effort required for design and construction of a sheet pile wall is dependent on the type and location of the project. Coordination and cooperation among hydraulic, geotechnical, and structural engineers must be continuous from the inception of the project to final placement in operation. At the beginning, these engineering disciplines must consider alternative wall types and alignments to identify real estate requirements. Other disciplines must review the proposed project to determine its effect on existing facilities and the environment. Close coordination and consultation of the design engineers and local interests must be maintained throughout the design and construction process since local interests share the cost of the project and are responsible for acquiring rights-of-way, accomplishing relocations, and operating and maintaining the completed project. The project site should be subjected to visual inspection by all concerned groups throughout the implementation of the project from design through construction to placement in operation.

2-2. Alignment Selection

The alignment of a sheet pile wall may depend on its function. Such situations include those in harbor or port construction where the alignment is dictated by the water source or where the wall serves as a tie-in to primary structures such as locks, dams, etc. In urban or industrial areas, it will be necessary to consider several alternative alignments which must be closely coordinated with local interests. In other circumstances, the alignment may be dependent on the configuration of the system such as space requirements for an anchored wall or the necessary right-of-way for a floodwall/levee system. The final alignment must meet the general requirements of providing the most viable compromise between economy and minimal environmental impact.

a. Obstructions. Site inspections in the planning phase should identify any obstructions which interfere with alternative alignments or which may necessitate special construction procedures. These site inspections should be supplemented by information obtained from local agencies to locate underground utilities such as sewers, water lines, power lines, and telephone lines. Removal or relocation of any obstruction must be

coordinated with the owner and the local assuring agency. Undiscovered obstructions will likely result in construction delays and additional costs for removal or relocation of the obstruction. Contracts for construction in congested areas may include a requirement for the contractor to provide an inspection trench to precede pile driving.

b. Impacts on the surrounding area. Construction of a wall can have a severe permanent and/or temporary impact on its immediate vicinity. Permanent impacts may include modification, removal, or relocation of existing structures. Alignments which require permanent relocation of residences or businesses require additional lead times for implementation and are seldom cost effective. Particular consideration must be given to sheet pile walls constructed as flood protection along waterfronts. Commercial operations between the sheet pile wall and the waterfront will be negatively affected during periods of high water and, in addition, gated openings through the wall must be provided for access. Temporary impacts of construction can be mitigated to some extent by careful choice of construction strategies and by placing restrictions on construction operations. The effects of pile driving on existing structures should be carefully considered.

c. Rights-of-way. In some cases, particularly for flood protection, rights-of-way may already be dedicated. Every effort should be made to maintain the alignment of permanent construction within the dedicated right-of-way. Procurement of new rights-of-way should begin in the feasibility stage of wall design and should be coordinated with realty specialists and local interests. Temporary servitudes for construction purposes should be determined and delineated in the contract documents. When possible, rights-of-way should be marked with permanent monuments.

d. Surveys. All points of intersection in the alignment and all openings in the wall should be staked in the field for projects in congested areas. The field survey is usually made during the detailed design phase. The field survey may be required during the feasibility phase if suitability of the alignment is questionable. The field survey should identify any overhead obstructions, particularly power lines, to ensure sufficient vertical clearance to accommodate pile driving and construction operations. Information on obstruction heights and clearances should be verified with the owners of the items.

2-3. Geotechnical Considerations

Because sheet pile walls derive their support from the surrounding soil, an investigation of the foundation materials along the wall alignment should be conducted at the inception of the planning for the wall. This investigation should be a cooperative effort among the structural and geotechnical engineers and should include an engineering geologist familiar with the area. All existing data bases should be reviewed. The goals of the initial geotechnical survey should be to identify any poor foundation conditions which might render a wall not feasible or require revision of the wall alignment, to identify subsurface conditions which would impede pile driving, and to plan more detailed exploration required to define design parameters of the system. Geotechnical investigation requirements are discussed in detail in Chapter 3 of this EM.

2-4. Structural Considerations

a. Wall type. The selection of the type of wall, anchored or cantilever, must be based on the function of the wall, the characteristics of the foundation soils, and the proximity of the wall to existing structures.

(1) Cantilever walls. Cantilever walls are usually used as floodwall or as earth retaining walls with low wall heights (10 to 15 feet or less). Because cantilever walls derive their support solely from the foundation soils, they may be installed in relatively close proximity (but not less than 1.5 times the overall length of the piling) to existing structures. Typical cantilever wall configurations are shown in Figure 2-1.

(2) Anchored walls. An anchored wall is required when the height of the wall exceeds the height suitable for a cantilever or when lateral deflections are a consideration. The proximity of an anchored wall to an existing structure is governed by the horizontal distance required for installation of the anchor (Chapter 5). Typical configurations of anchored wall systems are shown in Figure 2-2.

b. Materials. The designer must consider the possibility of material deterioration and its effect on the structural integrity of the system. Most permanent structures are constructed of steel or concrete. Concrete is capable of providing a long service life under normal circumstances but has relatively high initial costs when compared to steel sheet piling. They are more difficult to install than steel piling. Long-term field observations indicate that steel sheet piling provides a long service

life when properly designed. Permanent installations should allow for subsequent installation of cathodic protection should excessive corrosion occur.

(1) Heavy-gauge steel. Steel is the most common material used for sheet pile walls due to its inherent strength, relative light weight, and long service life. These piles consist of interlocking sheets manufactured by either a hot-rolled or cold-formed process and conform to the requirements of the American Society for Testing and Materials (ASTM) Standards A 328 (ASTM 1989a), A 572 (ASTM 1988), or A 690 (ASTM 1989b). Piling conforming to A 328 are suitable for most installations. Steel sheet piles are available in a variety of standard cross sections. The Z-type piling is predominantly used in retaining and floodwall applications where bending strength governs the design. When interlock tension is the primary consideration for design, an arched or straight web piling should be used. Turns in the wall alignment can be made with standard bent or fabricated corners. The use of steel sheet piling should be considered for any sheet pile structure. Typical configurations are shown in Figure 2-3.

(2) Light-gauge steel. Light-gauge steel piling are shallow-depth sections, cold formed to a constant thickness of less than 0.25 inch and manufactured in accordance with ASTM A 857 (1989c). Yield strength is dependent on the gauge thickness and varies between 25 and 36 kips per square inch (ksi). These sections have low-section moduli and very low moments of inertia in comparison to heavy-gauge Z-sections. Specialized coatings such as hot dip galvanized, zinc plated, and aluminized steel are available for improved corrosion resistance. Light-gauge piling should be considered for temporary or minor structures. Light-gauge piling can be considered for permanent construction when accompanied by a detailed corrosion investigation. Field tests should minimally include PH and resistivity measurements. See Figure 2-4 for typical light-gauge sections.

(3) Wood. Wood sheet pile walls can be constructed of independent or tongue-and-groove interlocking wood sheets. This type of piling should be restricted to short-to-moderate wall heights and used only for temporary structures. See Figure 2-5 for typical wood sections.

(4) Concrete. These piles are precast sheets 6 to 12 inches deep, 30 to 48 inches wide, and provided with tongue-and-groove or grouted joints. The grouted-type joint is cleaned and grouted after driving to provide a reasonably watertight wall. A bevel across the pile bottom, in the direction of pile progress, forces one pile

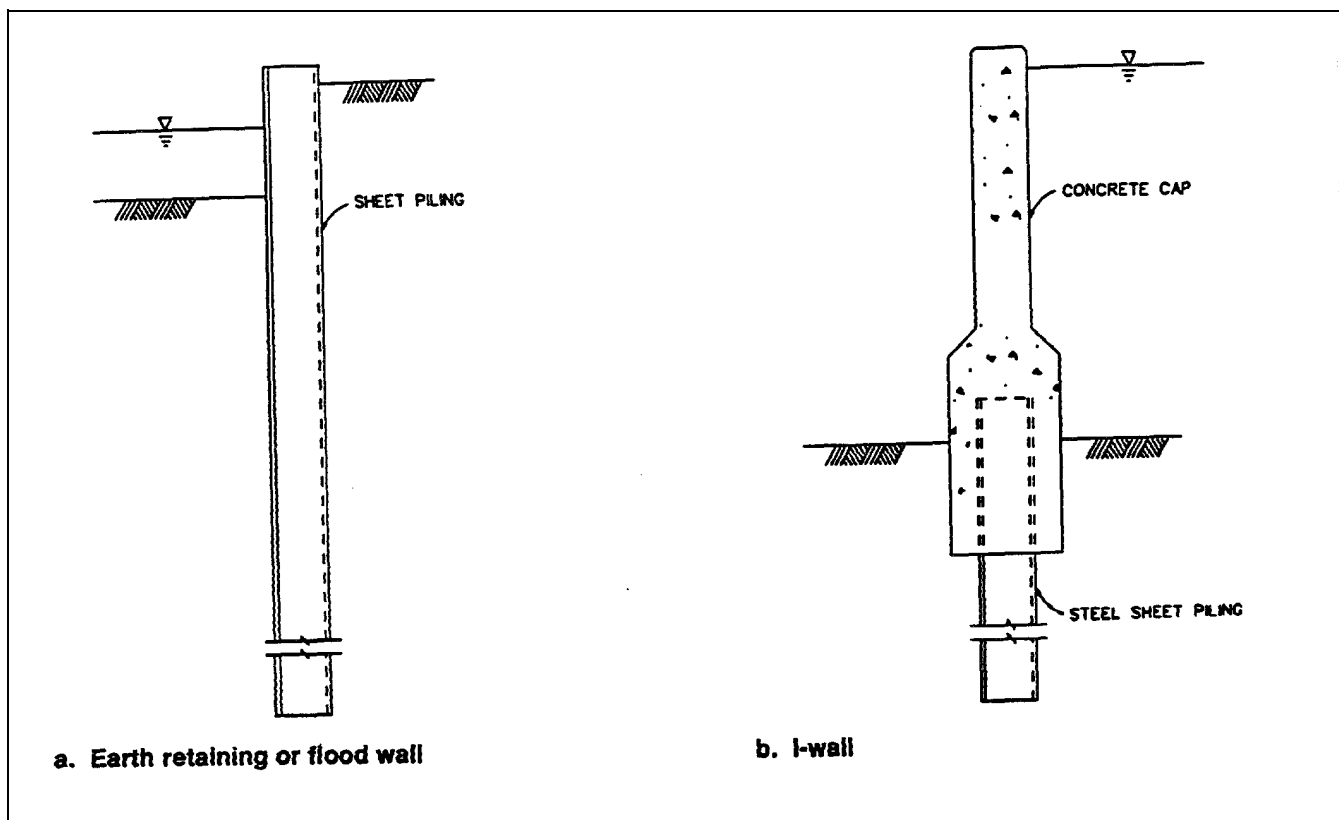


Figure 2-1. Typical cantilevered walls

against the other during installation. Concrete sheet piles are usually prestressed to facilitate handling and driving. Special corner and angle sections are typically made from reinforced concrete due to the limited number required. Concrete sheet piling can be advantageous for marine environments, streambeds with high abrasion, and where the sheet pile must support significant axial load. Past experience indicates this pile can induce settlement (due to its own weight) in soft foundation materials. In this case the watertightness of the wall will probably be lost. Typical concrete sections are shown in Figure 2-6. This type of piling may not be readily available in all localities.

(5) Light-gauge aluminum. Aluminum sheet piling is available as interlocking corrugated sheets, 20 to 4 inches deep, 0.10 to 0.188 inch thick, and made from aluminum alloy 5052 or 6061. These sections have a relatively low-section modulus and moment of inertia necessitating tiebacks for most situations. A Z-type section is also available in a depth of 6 inches and a thickness of up to 0.25 inch. Aluminum sections should be considered for shoreline erosion projects and low

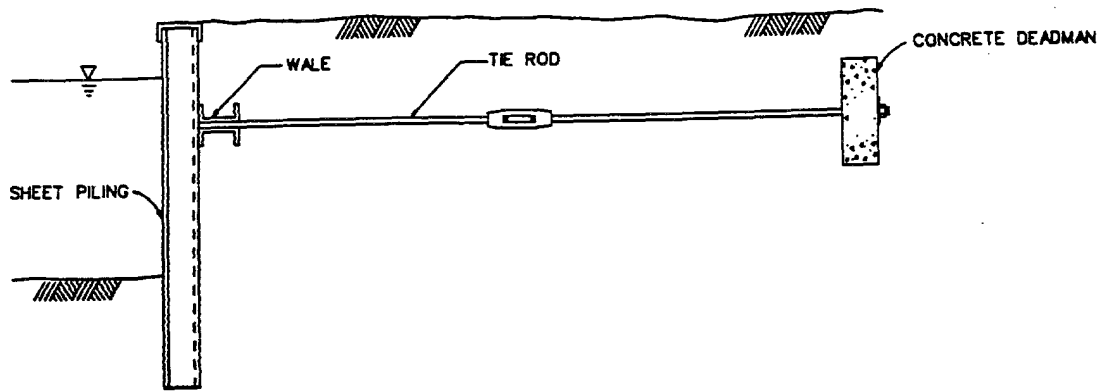
bulkheads exposed to salt or brackish water when embedment will be in free-draining granular material. See Figure 2-7 for typical sections.

(6) Other materials. Pilings made from special materials such as vinyl, polyvinyl chloride, and fiberglass are also available. These pilings have low structural capacities and are normally used in tie-back situations. Available lengths of piling are short when compared to other materials. Material properties must be obtained from the manufacturer and must be carefully evaluated by the designer for each application.

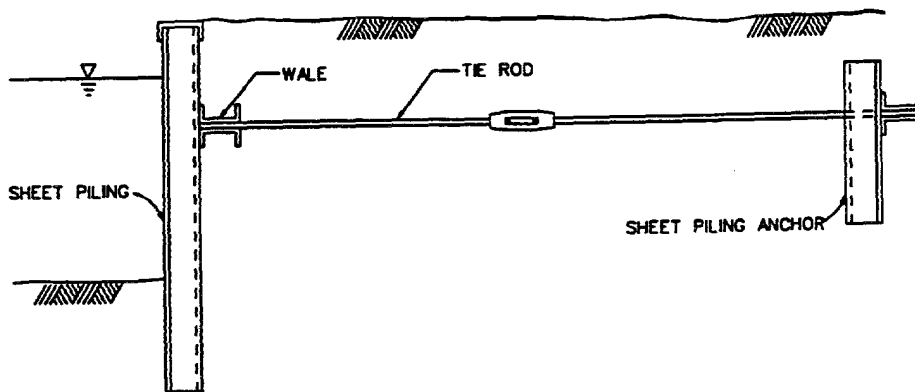
2-5. Construction

Instructions to the field are necessary to convey to field personnel the intent of the design. A report should be prepared by the designer and should minimally include the following:

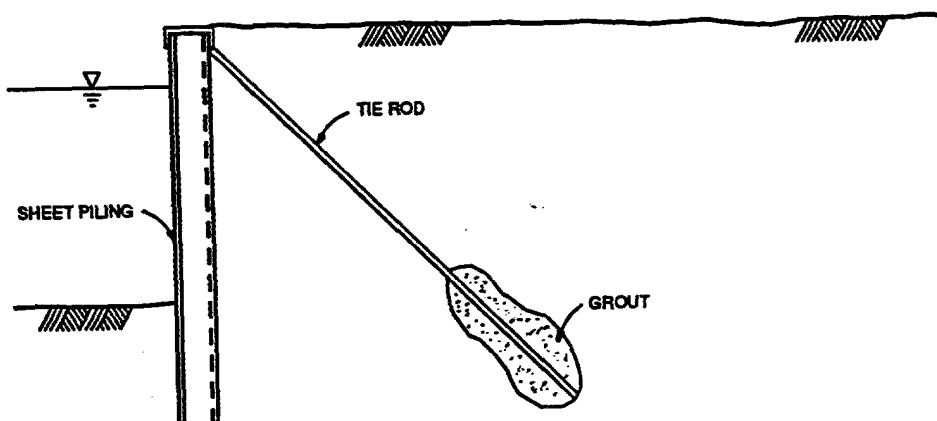
a. Design assumptions regarding interpretation of subsurface and field investigations.



a. Tie rods and dead man

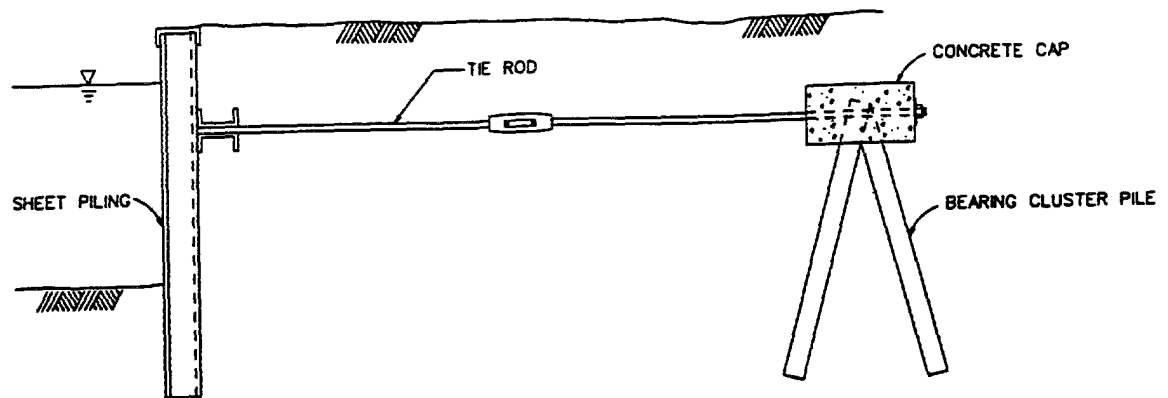


b. Tie rods and anchor wall

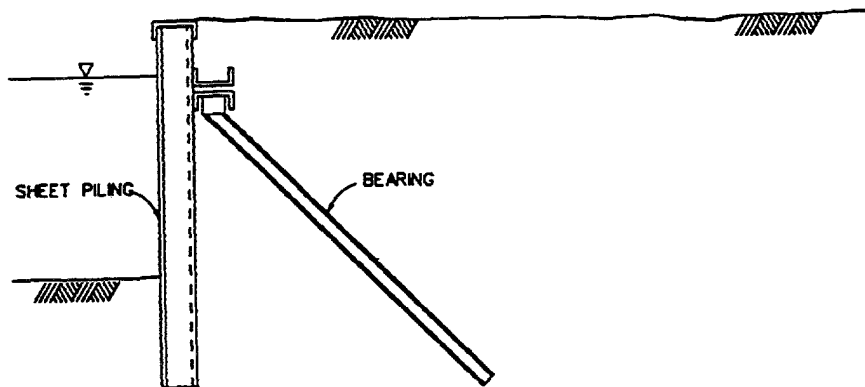


c. Tiebacks with grout anchor

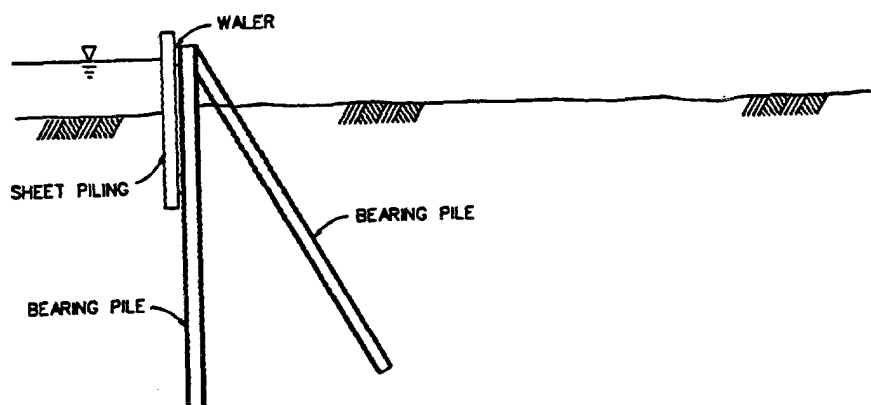
Figure 2-2. Anchored walls (Continued)



d. Tie rods and A-frame



e. Steel H-pile tension anchors



f. Steel H-pile anchors

Figure 2-2. (Concluded)

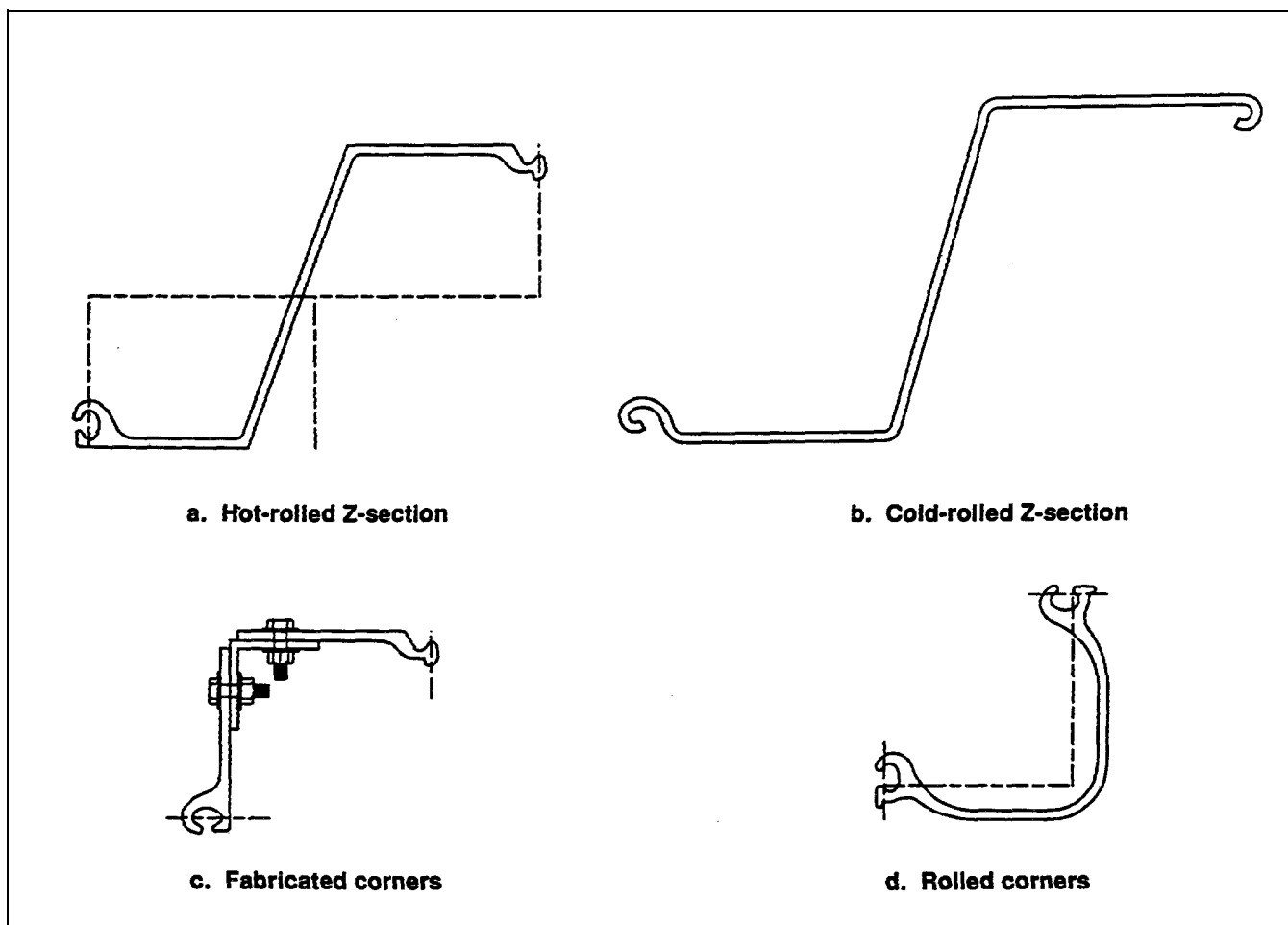


Figure 2-3. Typical heavy-gauge steel piling

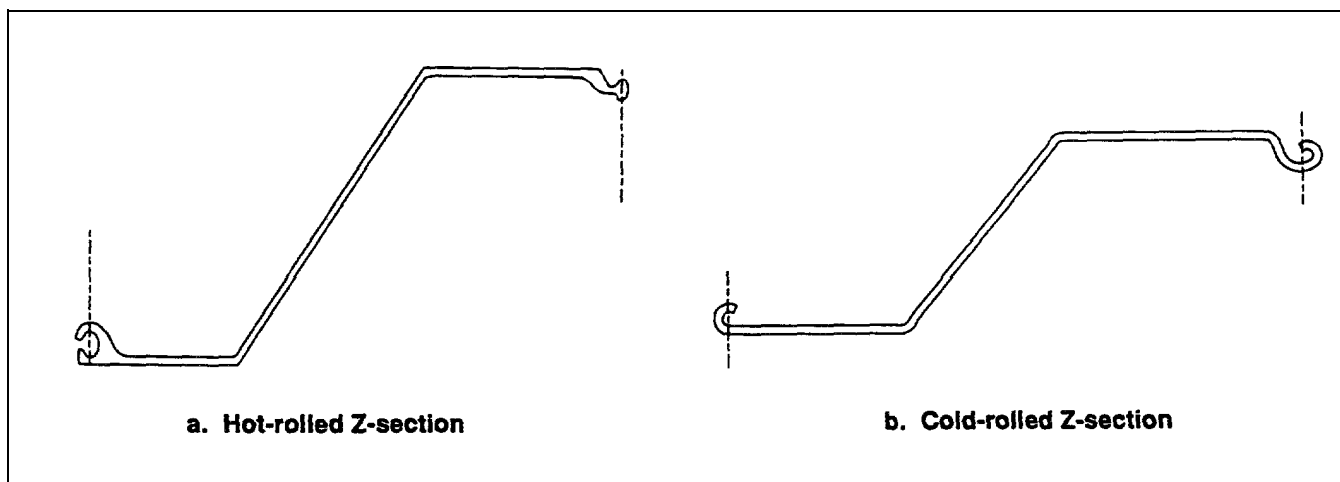


Figure 2-4. Typical light-gauge steel piling

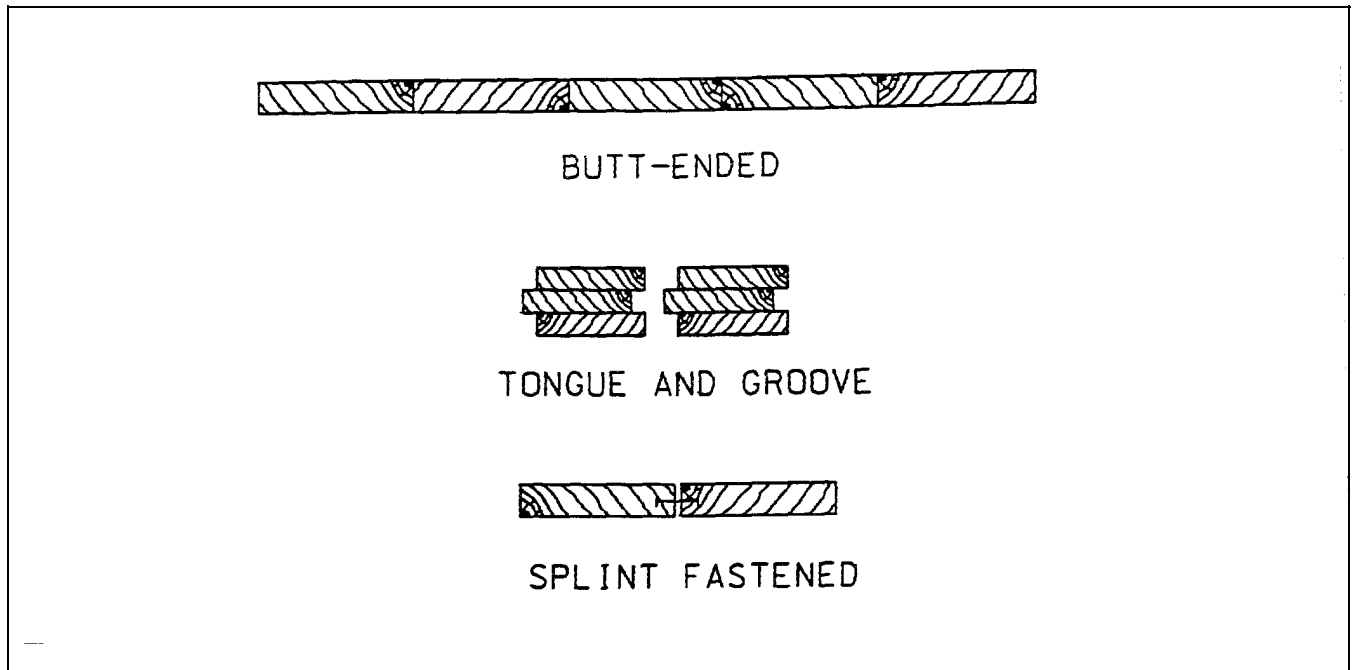


Figure 2-5. Typical wood sections

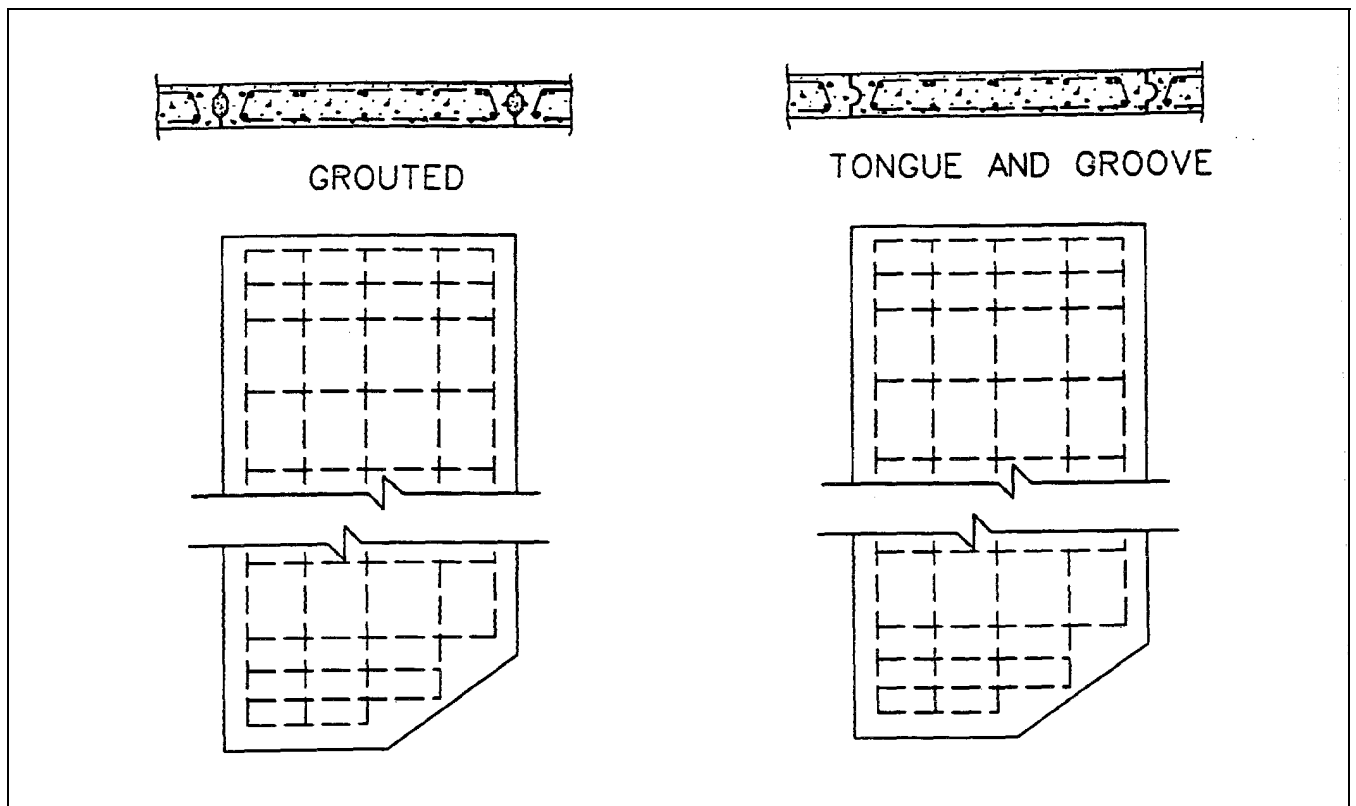


Figure 2-6. Typical concrete sections

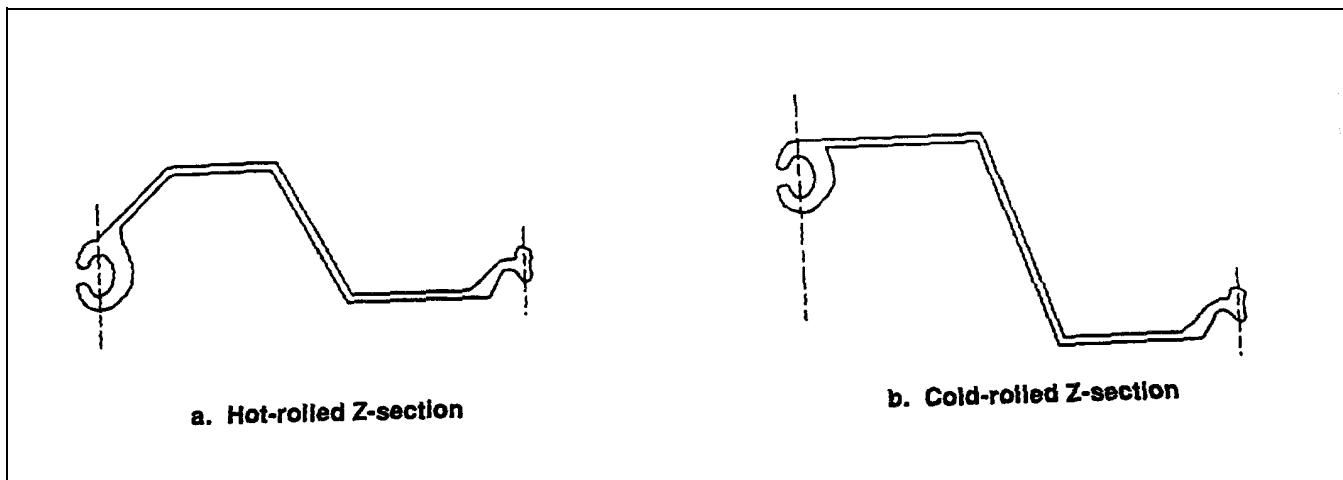


Figure 2-7. Typical aluminum sheet piling

b. Explanation of the concepts, assumptions, and special details of the design.

c. Assistance for field personnel in interpreting the plans and specifications.

d. Indication to field personnel of critical areas in the design which require additional control and inspection.

2-6. Postconstruction Architectural Treatment and Landscaping

Retaining walls and floodwalls can be esthetically enhanced with architectural treatments to the concrete and landscaping (references EM 1110-1-2009 and EM 1110-2-301, respectively). This is strongly recommended in urbanized areas.